REMARKS

The rejections against all of claims 1, 4, and 6 to 9 fall away on the basis that Christian (European patent application publication EP-A-1059776) does not constitute prior art citable under 35 USC 103(a).

The present application claims a priority date of 16th February 2000. This is before the date of publication of the Christian document of 13th December 2000.

Even if, and this is not the case, Christian were citable, Rostoker in view of Christian and Lee does not disclose all of the features of amended claim 1 and amended claim 8.

At least the feature of "applying time diversity to the header but not the video payload" is not disclosed by any of the cited art.

The Examiner is correct that Lee teaches that communication of the header (symbols) should be made as reliable as possible (Lee column 1 line 67 and column 2 lines 1 to 4). However it goes on to disclose solutions such as:

(1) placing headers next to a training sequence (Lee column 2 lines 6 to 7),

(2) interleaving data and header together (Lee, column 2 line 10), and

(3) shifting header bits to locations in a burst having a lower probability of incurring a bit error.

These solutions teach away from the present invention according to amended claims 1 and 8.

The present invention provides a useful alternative.

The remaining dependent claims 4, 6, 7 and 9 are patentable not least on the basis that they each depend on an allowable independent claim.

In view of the above, applicants respectfully request reconsideration and allowance. In the event of any fees inadvertently omitted or any improper payment of fees, the Commissioner is hereby authorized to charge or credit Lucent Technologies

Deposit Account No.12-2325 to correct the error now or during the pendency of this application.

If the Examiner has any questions or feels that a telephone conversation would be helpful, please contact Julio Garceran at (908) 582-7294.

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Two Burst Based Link Quality Control Proposal for EGPRS

1 Introduction

This paper describes a Two Burst Based (2BB) Link Quality Control (LQC) scheme for EGPRS. The proposed scheme is a merge of the schemes earlier proposed in [1], [2] and [3], it further follows the guidelines stated in [4].

As in [1], [2] and [3], the proposed scheme is a combined Link Adaptation (LA) and Incremental Redundancy (IR) scheme (D=1). The initial code rate may be selected based on link quality measurements. IR operation is enabled by puncturing a different set of bits for retransmissions (P1-P3). Different switching points for selecting the initial code rate may be used in the LA and IR mode. As for standard GPRS, selective ARQ is used and ACK/NACKs are signalled using bitmaps. Notice that the protected header is always interleaved over 4 bursts.

The unique feature of the scheme proposed here is that *two* RLC blocks are transmitted per 20 ms for the two highest data rate cases. This can be compared to one in [1], and four and six in [2] and [3] respectively. This approach enables better performance with frequency hopping compared to [1], while limiting the ACK/NACK bitmap size and allowing robust header coding compared to [2] and [3].

This paper describes the basic operation of the proposed scheme in terms of modulation, coding and puncturing. A performance evaluation is given in [5].

2 Modulation and Coding Schemes

The different Modulation and Coding Schemes (MCSs) are depicted in Table 1 and Figure 1. The MCSs are divided into different families: A, B and C. Each family has a different basic unit of payload: 37, 28 and 22 octets respectively. Note that the unit of payload should not be seen as the RLC block. Different code rates within a family are achieved by transmitting a different number of payload units within a 20 ms block. For family A and B, 1, 2 or 4 payload units are transmitted, for family C only 1 or 2 units are transmitted[1].

In cases where 4 payload units are transmitted (MCS-7[2] and MCS-8), these are split into two RLC blocks (separate sequence numbers and CRCs). These blocks in turn are interleaved over 2 bursts only. This approach yields better performance than interleaving over 4 bursts for high code rates. The effect of this is most evident when the burst quality is uncorrelated, as e.g. when using frequency hopping.

In order to support IR operation also in the GMSK modes, these modes are not equal to standard GPRS. Despite the somewhat lower peakrates, it is expected that this approach yields better performance than standard GPRS.

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[1] Transmitting 4 units for family C is not deemed a necessary MCS

[2] Interleaving over four bursts may be considered for MCS-7 if future simulations show that it is beneficial

2.1 Switching Between Modulation and Coding Schemes

For initial transmissions, any MCS can be selected based on the current link quality. For retransmissions in the LA mode that require increased robustness, two alternatives exist: If MCS-7 or MCS-8 was initially used, the block can be retransmitted at half the original code rate using one MCS-5 or MCS-6 block respectively. If MCS-4, MCS-5 or MCS-6 was initially used, the block can be retransmitted using two MCS-1, MCS-2 or MCS-3 blocks respectively. In the latter case two bits in the header will indicate that the RLC block has been split and the order of the parts.

For example, by applying both these steps, a block that was initially transmitted using uncoded 8-PSK can be retransmitted using the GMSK based MCS-3.

Scheme	Modulation	Maximum rate [kbps]	Code Rate	Header Code Rate (Sec. 3)	Blocks per 20 ms	Family
MCS-8	8PSK	59.2	1.0	0,35	2	A
MCS-7		44.8	0.76	0.35	2	B
MCS-6		29.6	0.49	1/3	1	A
MCS-5		22.4	0.37	1/3	1	B
MCS-4	GMSK	17.6	1.0	1/2	1	C
MCS-3		14.8	0.80	1/2	1	A
MCS-2		11.2	0.66	1/2	1	B
MCS-1		8.8	0.53	1/2	1	C

Table 1. Proposed modulation and coding schemes

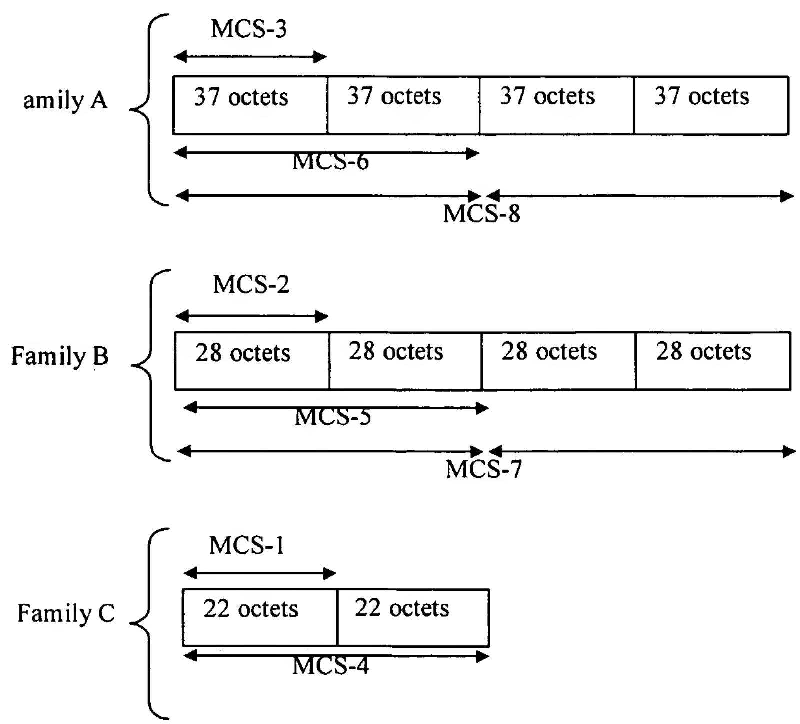

Figure 1. Proposed modulation and coding schemes

3 Header Format

The downlink RLC/MAC header fields are given in Table 2. In addition to the standard GPRS header fields, the proposed scheme introduces a field that indicates the Coding and Puncturing Scheme (CPS) used, and a field that indicates if an RLC block has been split for MCS1-3 (BS). Beyond strong protection for BSN and TFI, it is proposed that PT, S/P and RRBP fields should also be the part of the protected header. This will allow, for example, polling an MS and receiving the PACKET CONTROL ACKNOWLEDGMENT on the uplink even in cases where payload part is corrupted.

The different header formats are shown in Figure 2 - Figure 4. Basically, for MCS-7 and MCS-8, two SN fields are used, and for the GMSK based MCS-1 – MCS-4, the SPB field is introduced. Which header format is used is indicated using stealing bits. Notice that the stealing bits do not indicate the used MCS. Tail biting is used to minimise the size of the coded header.

The same protected headers are used in both LA and IR mode.

RLC/MAC Header Field	Size (bits)	Extra Protection
Uplink State Flag (USF)	3	GPRS like
Supplementary/Polling (S/P)	1	Yes
Relative Reserved Block Period (RRBP)	2	Yes
Payload Type (PT)	2	Yes
Temporary Flow Identifier (TFI)	7	Yes
Block Sequence Number (BSN)	10	Yes
Final Block Indicator (FBI)	1	No
Extension (E) bit	1	No
Coding and Puncturing Scheme (CPS)	2-5	Yes
Split Block (SPB)	2	Yes

Table 2. Downlink RLC/MAC header fields

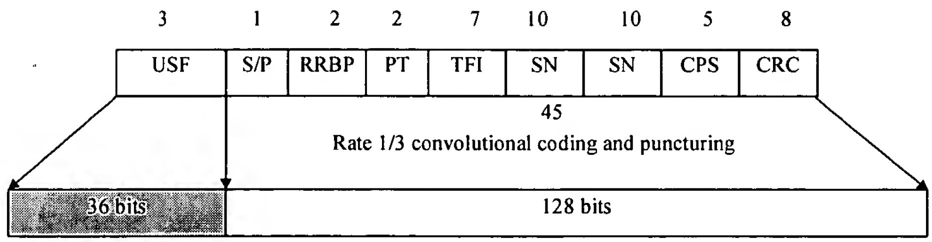

Figure 2. Header format for MCS-7 and MCS-8; 2 sequence numbers

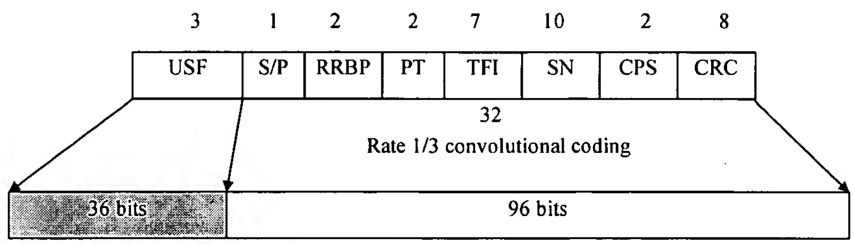

Figure 3. Header format for MCS-5 to MCS-6; one sequence number

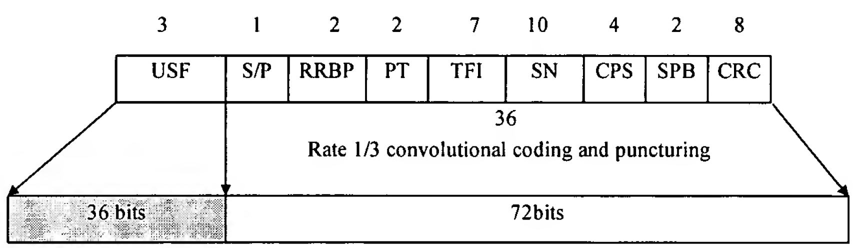

Figure 4. Header format for MCS-1 to MCS-4; one sequence number, extra field indicating split block

4 Coding and Puncturing

In this section more details of the coding and puncturing used for all MCSs are given. This is done based on the following assumptions:

- 1392 bits per 8PSK block, 464 bits per GMSK block
- 36 bits 8PSK USF, 12 bits for GMSK USF (as CS-4)
- 4 (?) Stealing Bits (SB) for 8PSK indicating two different header types; 8 stealing bits for GMSK indicating CS-4 (only one header type)
- Coded RLC headers according to previous section
- 2 bits for FBI and E fields (header part coded at same rate as payload)
- 12 bit CRC and 6 bit tail for payload

In addition to extra protection for USF, the TFI, BSN, S/P, RRBP and PT fields will also be protected irrespective of the fact that IR is used or not. This is due to the fact that we want to keep both LA and IR modes as similar as possible to each other.

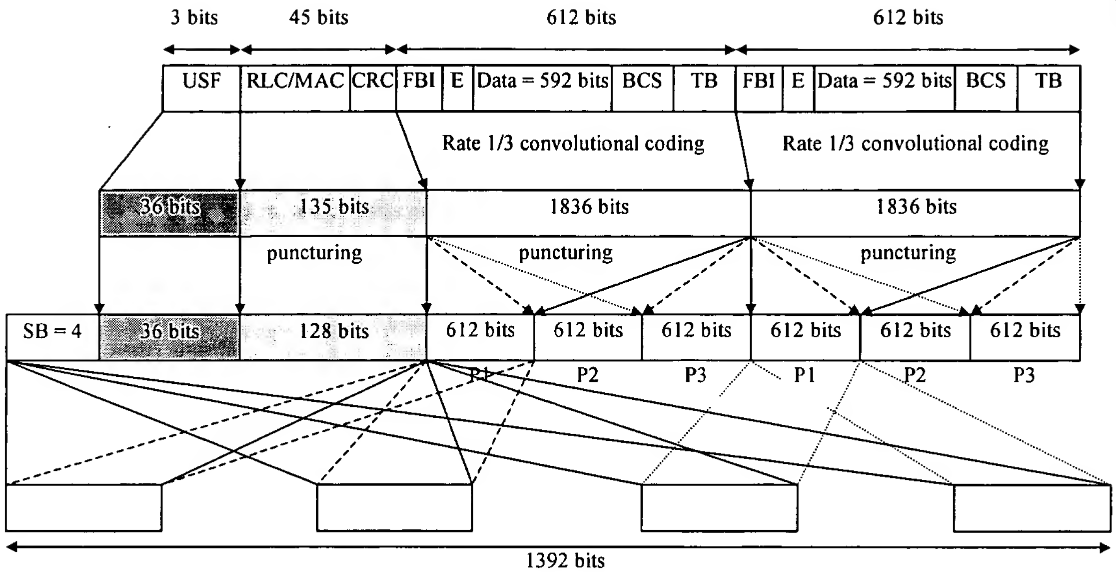

Figure 5. Coding and puncturing for MCS-8; uncoded 8PSK, two RLC blocks per 20 ms

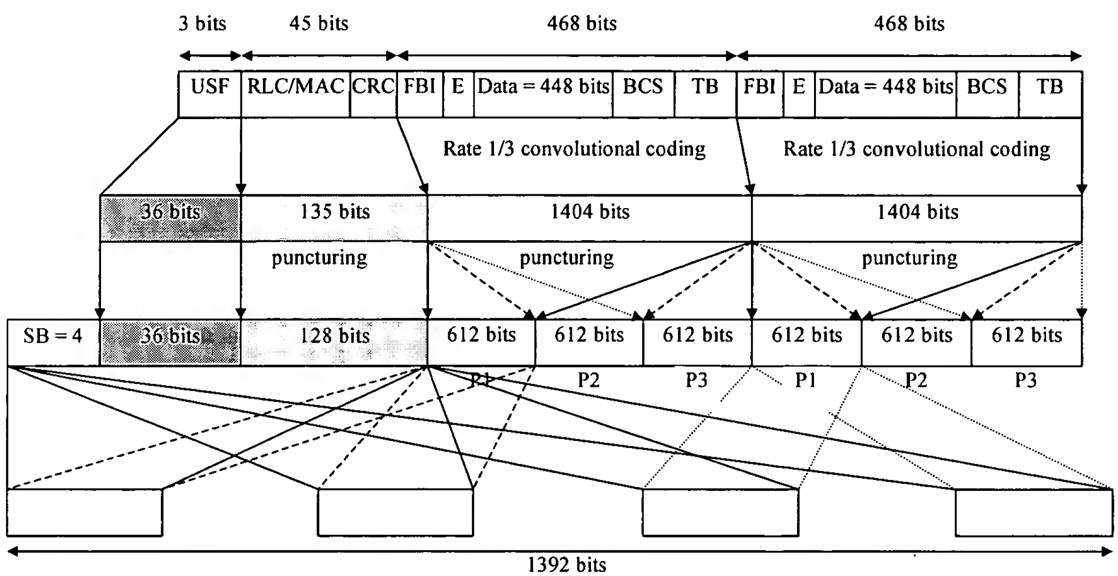

Figure 6. Coding and puncturing for MCS-7; rate 0.76 8PSK, two RLC blocks per 20 ms

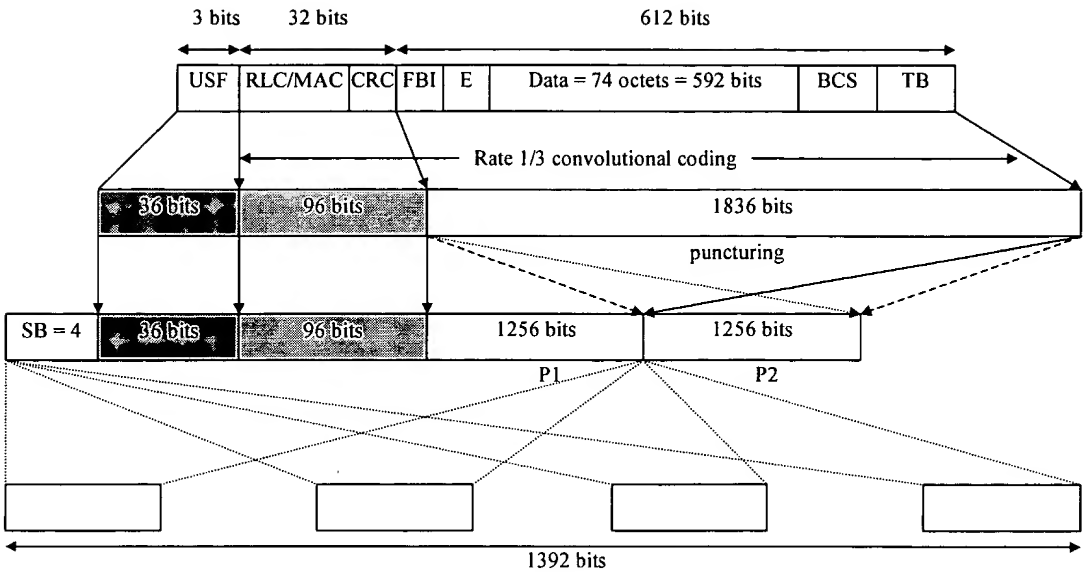

Figure 7. Coding and puncturing for MCS-6; rate 0.49 8PSK, one RLC block per 20 ms

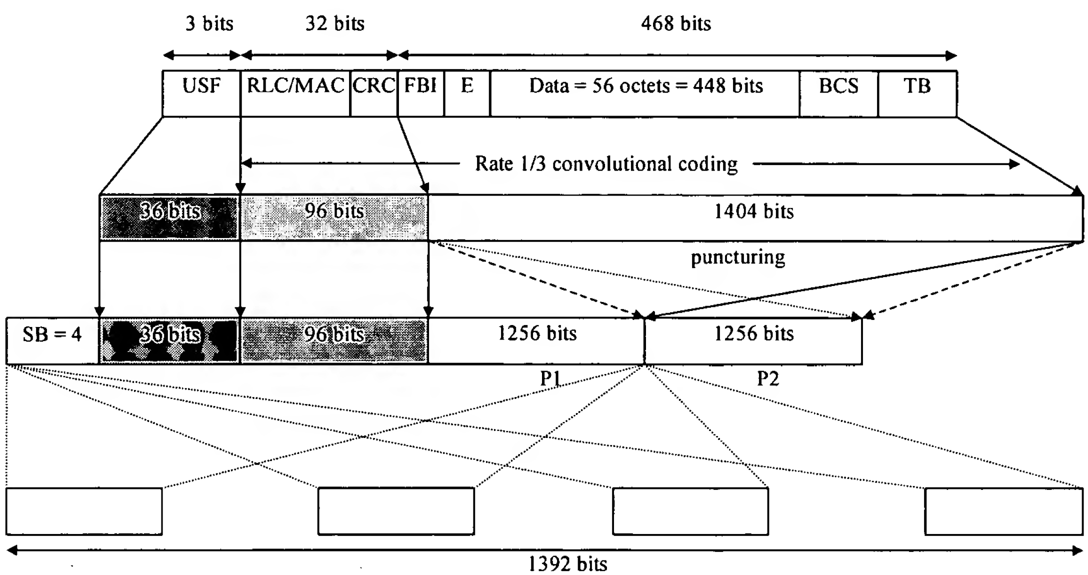

Figure 8. Coding and repetition for MCS-5; rate 0.37 8PSK, one RLC block per 20 ms

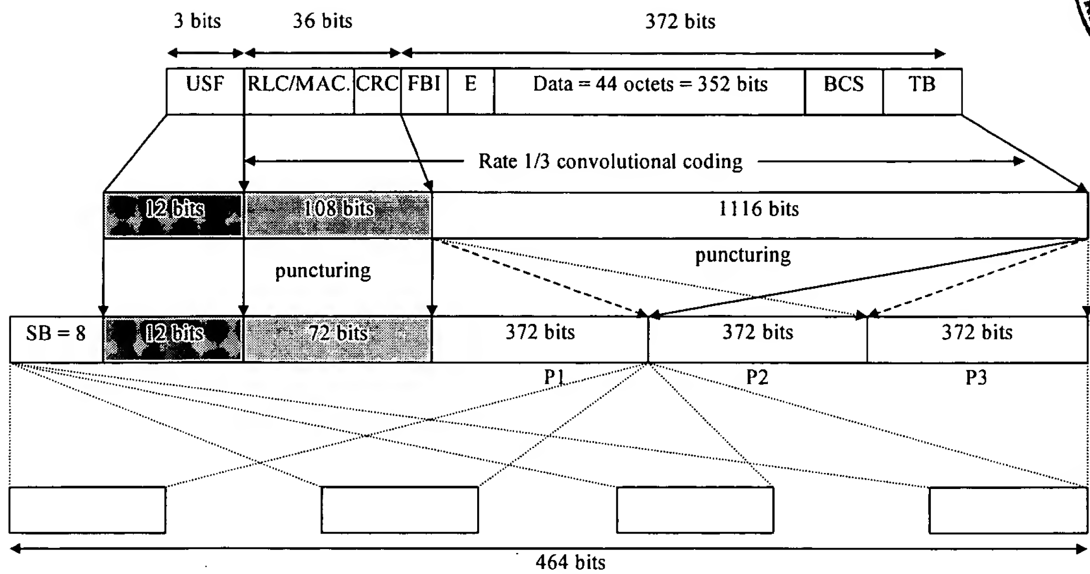

Figure 9. Coding and puncturing for MCS-4; uncoded GMSK, one RLC block per 20 ms

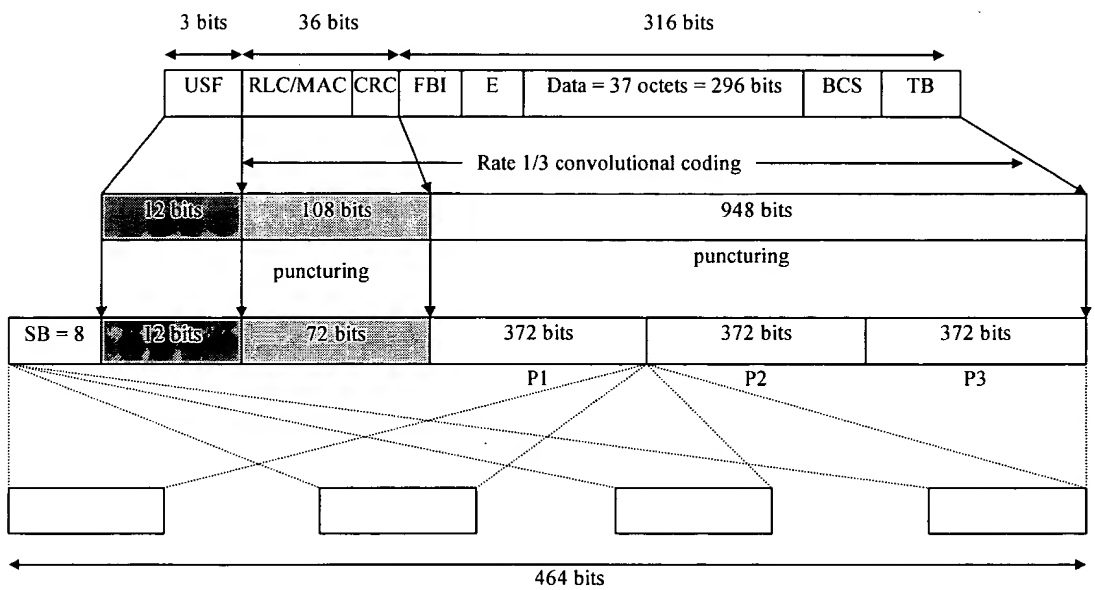

Figure 10. Coding and puncturing for MCS-3; rate 0.80 GMSK, one RLC block per 20 ms

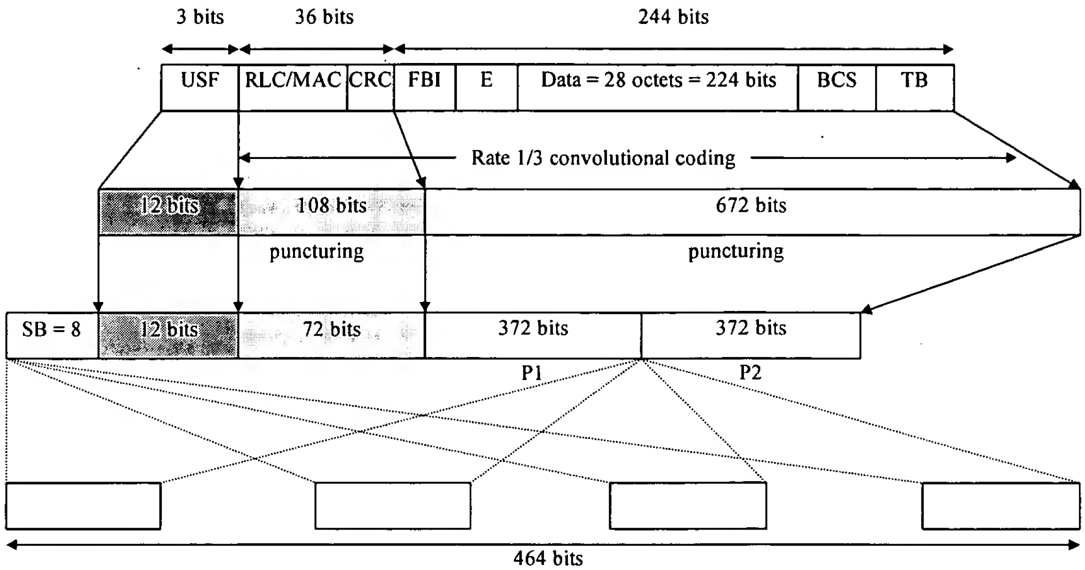

Figure 11. Coding and puncturing for MCS-2; rate 0.66 GMSK, one RLC block per 20 ms

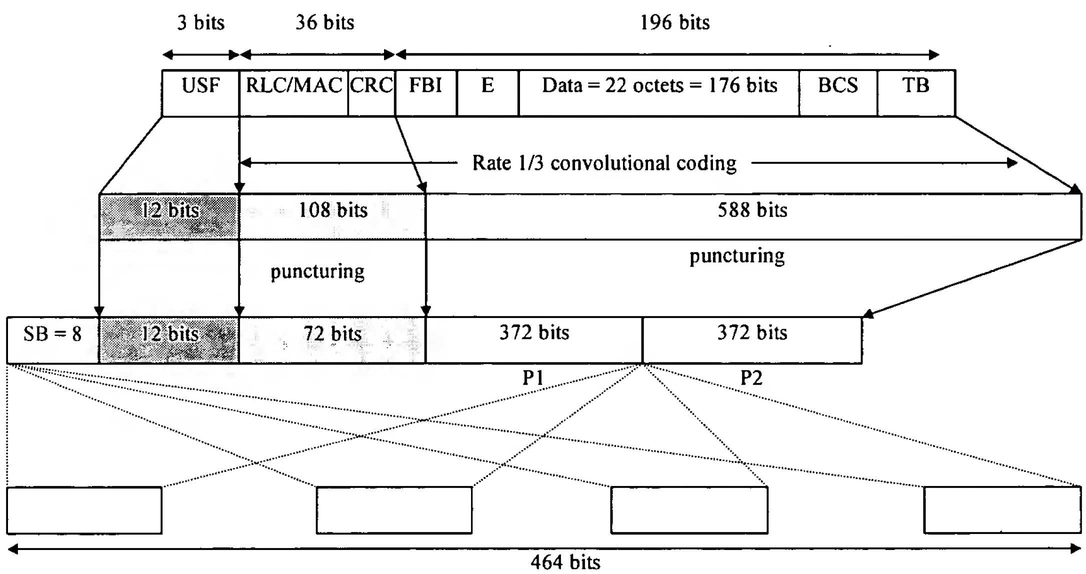

Figure 12. Coding and puncturing for MCS-1; rate 0.53 GMSK, one RLC block per 20 ms

5 ACK/NACK Signalling

An extended bitmap (2 times more bits) will be required for MCS-7 and MCS-8 due to the fact that a twice as large number of RLC blocks have to be acknowledged per unit time. This requires more bits for ACK/NACK signalling. CS-1 coding is used to carry the ACK/NACK message. When the bitmap is larger than 64 bits, measurement reports are dropped from the ACK/NACK message, thus accommodating bitmaps up to 128 bits. By using compression of bitmaps [6], the frequency at which measurement reports need to be dropped is reduced. When the bitmap itself (or the compressed bitmap), is longer than 128 bits, a bitmap that contains only a portion of the receiver window is transmitted in the ACK/NACK message, as could be considered for GPRS.

6 Effects of Non-GPRS GMSK Mode

The GMSK mode of the proposed scheme is not identical to GPRS. Multiplexing of EGPRS and standard GPRS users is still possible, either through fixed allocation or dynamic allocation using USF granularity.

The dynamic allocation using USF granularity requires that a GPRS MS can read the USF in an EGPRS GMSK block. This is enabled by letting the stealing bits in the EGPRS GMSK blocks indicate CS-4, and coding and interleaving the USF as for CS-4. This leads to the following:

1. A standard GPRS MS will be able to detect the USF in EGPRS GMSK blocks. The risk that the rest of the block will be misinterpreted as valid information is assumed to be low.

2. An EGPRS MS can not differentiate CS-4 blocks and EGPRS GMSK blocks by only looking at the stealing bits. This is however not needed for USF detection, since the USF is signalled in the same way. Further, assuming that the EGPRS MS knows if it is in EGPRS or standard GPRS mode, it will only have to try to decode the remainder of the GMSK blocks in one way in order to determine if they were aimed for it.

7 References

[1] ETSI Tdoc SMG2 EDGE 095/98, “Link Quality Control Proposal for EGPRS”

[2] ETSI Tdoc SMG2 EDGE 103/98, “Burst Based Link Quality Control Proposal for EGPRS”

[3] ETSI Tdoc SMG2 EDGE 098/98, “Link Adaptation and Incremental Redundancy for EGPRS”

[4] ETSI Tdoc SMG2 EDGE 126/98, “Proposed way forward on link quality control aspects for EDGE”

[5] ETSI Tdoc SMG2 WPB 004/99, “EDGE: Two Burst Based LQC Performance”

[6] ETSI Tdoc SMG2 WPA/WPB XXX/99 (to be submitted), “Lucent paper on bitmap compression”